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This bibliography lists 155 books, articles, monographs, and other studies on operations analysis in education. The criteria for inclusion are that the study be quantitative and analytical and use techniques of operations research, systems analysis, management science, program planning and budgeting, benefit analysis, cost analysis, benefit-cost analysis, cost effectiveness analysis, multivariate statistical methods, economics, or computer science. A list of six bibliographies which include most of the studies cited and a list of 38 Technical Notes of the Division of Operations Analysis that are available through ERIC are appended. This document replaces ED 014 129. (HW)

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DIVISION OF DATA ANALYSIS AND DISSEMINATION

A BIBLIOGRAPHIC GUIDE TO OPERATIONS ANALYSIS OF EDUCATION

by

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A Bibliographic Guide to Operations Analysis of Education

The number of meritorious, quantitative, analytical studies which have been made and are being made in education is very large. Those of such studies which have been selected for inclusion in this bibliography have been selected largely because of the way they have been conducted or are designed to be conducted. A study is included if it uses techniques of:

Operations Research
Systems Analysis
Management Science
Program Planning and Budgeting
Benefit Analysis
Cost Analysis
Benefit-Cost Analysis
Cost Effectiveness Analysis

If a mixture of such a technique with others occurs, and the technique is still the major one of the study and is an exemplary use of the technique, the study is included.

Three other methodological areas have added considerable impetus to the development of the above list of methodology types. These are multivariate statistical methods, economics, and computer science. Selected studies of these sorts are included if they are either pioneering works in their area, works which give a comprehensive account of an important area, or recent works which show promise of contributing to future developments in the methodologies listed. Practically all studies have a quantitative basis and mention variables to be measured and related; where this is not the case the structural implications of the study include measurements.

In addition to the bibliographies listed in Appendix A, page 17, many journals and other sources have been used in compiling the following list of books, articles, monographs, and notes on matters related to operations analysis in education.

The list is coded with each of the items classified according to the following scheme:

BC: Benefit cost analysis or
Cost effectiveness or
Cost analysis or
Benefit analysis

CS: Computer Science

EC: Economics

MG: Management Science

MV: Multivariate Statistical Methods

OR: Operations Research

PP: Program Planning and Budgeting

SA: Systems Analysis

1.OR Abt Associates, Inc. Survey of the State of the Art: Social, Political, and Economic Models and Simulations. A report for the National Commission of Technology, Automation, and Economic Progress. Cambridge, Massachusetts: November 1965.

2.BC Abt Associates, Inc. An Examination of Data on Iowa School Children, Abt to Determine Patterns of Performance and "Downstream Effects" of Early Depressed Scores. (Available through ERIC 1/ as Technical Note No. 8)

3.BC Abt Associates, Inc. An Overview of the Cost-Effectiveness Model and Submodels for the Evaluation of Title I ESEA Proposals. (Available through ERIC as Technical Note No. 14)

4.BC Abt Associates, Inc. The School Submodel (Available through ERIC as Technical Note No. 15)

1/ ERIC, which stands for Education Resources Information Center, is a nationwide information service maintained and co-ordinated by the Office of Education. Central ERIC, in Washington, D.C., publishes a monthly bulletin, Research in Education, which, in due time, will list all the Technical Notes, assigning them document numbers. All reports cited in Research in Education are available for sale in either microfiche or facsimile form from the ERIC Document Reproduction Service (EDRS) at reasonable cost. ERIC also maintains a network of clearinghouses which are responsible for information in a given area of Education.

The Technical Notes from the Division of Operations Analysis will be announced in Research in Education and made available for public sale through EDRS.

EDRS is currently operated by the Microphoto Division of the Bell and Howell Company, 1700 Shaw Avenue, Cleveland, Ohio, 44112. Copies of reports must be ordered by their individual ED numbers, which are provided, along with prices, by Research in Education.

5.BC Abt Associates, Inc. The Instructional Process Submodel
(Available through ERIC as Technical Note No. 16)

6.BC Abt Associates, Inc. The Community Submodel
(Available through ERIC as Technical Note No. 17)

7.BC Abt Associates, Inc. The Cost Submodel
(Available through ERIC as Technical Note No. 18)

8.BC Abt Associates, Inc. The Effectiveness Submodel
(Available through ERIC as Technical Note No. 19)

9.BC Abt Associates, Inc. The Simulation
(Available through ERIC as Technical Note No. 20)

10.BC Abt Associates, Inc. A Study of Longitudinal Patterns of Failure Among High School Dropouts and Poorly Performing Graduates.
(Available through ERIC as Technical Note No. 26)

11.OR Ackoff, Russell L. The Development and Nature of Operations Research and its Relevance to Educational-Media Research. Center for Instructional Communications. Syracuse University 1964, 22 pp. ERIC #ED002490.

12.EC Anderson, C.A. and Bowman, M.J. Education and Economic Development. Chicago: Aldine Publishing Co., 1965.

13.EC Arrow, Kenneth J. "The Economic Implications of Learning by Doing", Review of Economic Studies. June, 1962, pp. 155-173.

14.EC Astin, A.W. "Productivity of Under-Graduate Institutions", Science, Vol. 136, No. 3511, Apr. 13, 1962, pp. 129-135.

15.OR Barnard, G.A. "The Future of Operational Research", Operational Research Quarterly, Vol. 15, No. 2, June 1964, pp. 63-69.

16.OR Barson, J. and E.K. Oxhandler (Eds). Audio Visual Instruction, Vol. 10, No. 5, May 1965, 37 pages.

General theme: "Systems: An Approach to Improving Instruction" Twelve articles by twenty authors.

17.EC Becker, Gary S. "Investment in Human Capital: A Theoretical Analysis", Journal of Political Economy. Vol. 70, No. 5, Part 2, Oct. 1962, pp. 9-49.

18.EC Becker, Gary S. and Chiswich, Barry R. "Education and the Distribution of Earnings", American Economic Review, Paper and Proceedings of the 78th Annual Meeting, Vol. LVI, May 1962, pp. 358-369.

19.EC Becker, G.S. Human Capital, A Theoretical and Empirical Analysis with Special Reference to Education, Princeton University Press, 1964, 198 pages.

20.OR Beer, Stafford, "An Operational Research Project on Technical Education", OR Quarterly (UK), Vol. 13, 1962, No. 2 (June), pp. 179-199.

21.EC Blaug, M. "The Rate of Return on Investment in Education in Great Britain", The Manchester School, Vol. XXXIII, No. 3, September 1965.

22.SA Bolt, Richard H. "Doctoral Feedback into Higher Education", Science, Vol. 146, No. 3672, May 14, 1965, pp. 918-928.

23.BC Borus, Michael E. "A Benefit-Cost Analysis of the Economic Effectiveness of Retraining the Unemployed", Yale Economic Essays. Fall 1964, Vol. 4, pp. 371-429

24.EC Bowman, M.J. "Converging Concerns of Economists and Educators", Comparative Education Review, Vol. 6, No. 2, Oct. 1962, pp. 111-19.

The purpose of this article is to clarify the rate of return (i.e. allocative) approach to the task of analyzing investment in education. Author warns against exaggeration of loss of opportunity costs by including subsistence costs.

25.EC Bowman, M.J. "The New Economics of Education", Educational Sciences, an International Journal, Vol. 1, No. 1, 1966.

26.EC Carovano. J.M. "Financing Public Higher Education", 1969-1970, National Tax Journal, Vol. 19, No. 2, June 1966, pp. 125-137.

27.SA Carter, L.F., and H.F. Silberman. "The Systems Approach, Technology and the School", SDC Doc. SP-2025, Apr. 1965, 30 pp.

28.EC Chance, W.A. "Long-Term Labor Requirements and Output of the Educational System:, Southern Economic Journal, Vol. XXXII, No. 4, April 1966.

29.BC Ciriacy-Wantrup, S.V. "Benefit-Cost Analysis and Public Resources Development", Journal of Farm Economics, Vol. 37, Nov. 1955, pp. 676-689.

30.EC Clark, Harold F. Cost and Quality in Public Education, The Economics and Politics of Public Education, No. 5, Syracuse University Press, 1963.

31.MV Coleman, James, et al. "Equality of Educational Opportunity," Office of Education (OE 38001),1966.

32.BC Consolazio, W.V. "Substaining Academic Science", 1965-75, The Educational Record, Vol. 45, No. 2, pp. 210-229.

Cost analysis of need for funds to maintain present quality levels in mathematics, science and engineering.

33.EC Correa, Hector. The Economics of Human Resources. Amsterdam: North Holland Publishing Co., 1963.

34.EC Dennison, E.F. "Education, Economic Growth and Gaps in Information", J. Pol. Econ., Vol. 5, No. 5, Oct. 1962, pp. 124-8.

35.EC Denison, Edward. The Sources of Economic Growth in the United States and the Alternatives Before Us. New York: Committee for Economic Development, 1962.

36.BC Dorfman, Robert (Ed.) Measuring Benefits of Government Investments. Washington, D.C.: Brookings Institution, 1963.

37.EC Duncan, O.D. "Occupational Components of Educational Differences in Income", Journal of American Statistical Association, Vol. 56, 1961, pp. 783-92.

38.PP Eckstein, Otto. Water-Resources Development - The Economics of Project Evaluation. Massachusetts: Harverd University Press, 1961.

39.EC Eckstein, Otto. Public Finance. Englewood Cliffs, N.Y.: Prentice-Hall, 1964.

40.EC Economic Council of Canada. "Education and Economic Growth in Canada", Monthly Labor Review. April 1966, pp. 377-380.

41.SA Egbert, R.L., and J.F. Cogswell. "Systems Analysis and Design in Schools", System Development Corp., Report No. SP-1141, 6 Mar. 1963, 19 pages.

Innovation and individualized instruction with student proceeding at own pace emphasized. New instructional approaches in 2 high schools and a junior high school described. Flow chart of one. Algorithm for analysis of proposed school system: 1. goal identification, 2. model construction, 3. computer simulation, 4. documentation (interpretation of requirements), 5. feasibility (cost and social acceptability) study, 6. field test.

42.BC Enthoven, Alain C. "Economic Analysis in the Department of Defense", American Economic Review. Vol. 53, May 1963, pp. 413-423.

43.EC Ewers, Colin D. "Educational Planning Within the Framework of Economic Planning", International Review of Education, Vol. 10, No. 2, 1964, pp. 129-140.

Nine steps to estimating future educational needs. Manpower needs are included in first steps (1-4), then needs based on other considerations.

44.BC Exton, Lane. "The Word from Washington", American School Board Journal.

45.EC Faluvergi, L. "The Planning of Budgetary Expenditure on Education on the Basis of a Mathematical Model - The Method Employed in Hungary", Journal of Public Finance, Vol. XXI, No. 1, 1966.

46.EC Feldstein, Martin S. "Opportunity Cost Calculation in Cost-Benefit Analysis", Public Finance, Vol. 19, 1964, pp. 117-139.

47.EC Feldstein, Martin S. "The Social Time Preference Discount Rate In Cost-Benefit Analysis", Economic Journal, Vol. 74, June 1964, pp. 360-379.

48.MG Folger, John K., and Nam, Charles B. "Trends in Education in Relation to the Occupational Structure", Sociology of Education, Vol. 38, No. 1, Fall 1964, pp. 19-33.

49.EC Goode, Richard B. "Tax Treatment of Individual Expenditures for Education and Research", American Economic Review, Papers and Proceedings of the 78th Annual Meeting, Vol. LVI, May 1966, pp. 208-216.

50.CS Goodlad, John, et al. "Application of Electronic Data Processing Methods in Education", Department of Education UCLA, 1965.

51.EC Hansen, W.L. "Total and Private Rates of Return to Investment in Schooling", Journal of Political Economy, Vol. 71, April 1963, pp. 128-40.

52.EC Harbison, F. and C.A. Myers, "Education, Manpower and Economic Growth: Strategies of Human Resources Development", New York, McGraw Hill 1964. Reviewed by L.G. Reynolds, American Econ. Rev., Vol. 54, Sept. 1964.

Develops rationale for a set of human resource development indicators and applies them to 75 countries--Teachers, Scientists, Physicians per 10,000 population, percent of school age group in school.

53.EC Harbison, F. and C.A. Myers. "Manpower and Education", New York: McGraw Hill, 1965 (Country Studies in Economic Development).

54.CS Harnack, Robert S. "The Use of Electronic Computers to Improve Individualization of Instruction Through Unit Teaching, OECRP D-112, Feb. 1964-May 1965. Reviewed by author in Audio-visual Instruction, Jan. 1967, Vol. 12, No. 1, pp. 32-35.

55.EC Harris, Seymour E. The Economics of Higher Education. New York: Harper and Bros., 1961.

56.EC Harris, Seymour E. Higher Education: Resources and Finance. New York: McGraw-Hill, 1962.

57.EC Harris, S.E. (Ed) "Economic Aspects of Higher Education", OECD 1964 (U.S. Agent: McGraw-Hill Book Co., New York).

58.EC Hiner, Lawrence G. "The Hazards of Benefit-Cost Analysis As A Guide to Public Investment Policy", Public Finance. Vol. 17, No. 2, 1962, pp. 101-117.

59.EC Hirsch, W.Z. "Analysis of the Rising Costs of Public Education"

Study Paper No. 4, Joint Economic Committee, U.S. Congress, G.P.O., Washington, 1959.

60.MV Hirsch, W.Z. "Determinants of Public Education Expenditures", National Tax Journal, Vol. 13, March 1960, pp. 29-40.

Regression: A model is constructed to show per pupil expenditure or a similar dependent variable regressed on
1) number of pupils (in public schools)
2) square of item 1)
3) percent in high school
4) pupils per square mile
5) pupil percent increase in 51-56
6) valuation of property per pupil
7) index of scope & quality of public education.

61.EC Hirsch, W.Z. "Income Elasticity of Public Education", International Economic Review, Vol. 2, Sept. 1961, pp. 330-39.

Income elasticity defined as product of 1) regression coefficient relating expenditures per pupil to per capita personal income and 2) the ratio of average personal income to average school expenditures. Elasticities of 1.09 (US 1900-1958), .594 (51-52), .593 (54-55), .98 (St. Louis area 54-55) indicate lack of income elasticity of education for primary & secondary education.

62.BC Hirsch, Werner Z. and others. Spillovers of Public Education Costs and Benefits. Los Angeles: Institute of Government and Public Affairs, University of California, 1964.

63.PP Hirsch, W.Z. Education in the Program Budget. RM-4333-RC, Santa Monica, California: The Rand Corp., 1965.

64.BC Hirsch, W.Z. and M.J. Marcus. "Some Benefit-Cost Considerations of Universal Junior College Education", National Tax Journal, Vol. 19, No. 1, Mar. 1966, pp. 48-57.

A short but indicative Benefit-Cost study using tangible variables, 1960 data. Summer education viewed as an alternative to full-time study develops a higher B/C ratio.

65.BC Hollister, Robinson G. "A Decision Making Budget", The Educational Record, Jan. 1966, pp. 490-7.

66.BC Holtman, A.G. "A Note on Public Education and Spillovers Through Migration", Journal of Political Economy, Vol. 76, No. 5, pp. 524-5.

67.EC Houthakker, H.S. "Education and Income", Review of Economics and Statistics, Vol. 41, No. 1, Feb. 1959, pp. 24-28.

1950 Census data are used of make estimates of mean incomes for U.S. males cross-classified by eight education categories and twelve age categories. Coefficients of variation are provided to characterize the income distribution for these combinations (90 of them with adequate data). An after tax tabulation is also made and estimates are given of lifetime earnings of persons with each of the eight levels of education before and after taxes and with discount rates of zero, 3, 6, and 8 percent applied to earnings foregone while being educated.

68.MG Hoyle, Eric. "Organizational Analysis in the Field of Education", Educational Research (Feb. 1965), Vol. 7, No. 2.

A thoroughgoing discussion of this structure analytic approach to the social organization of schools. An eighty-item bibliography is included.

69.EC Hunt, S.J. "Income Determinants for College Graduates and the Return to Educational Investment", Yale Economic Essays, Fall 1963.

70.EC Intriligator, Michael D. and Smith, Bruce L.R. "Some Aspects of the Allocation of Scientific Effort Between Teaching and Research", American Economic Review, Paper and Proceedings of the 78th Annual Meeting, Vol. LVI, May 1966, pp. 494-507.

71.MV James, H.T.; J.A. Kelley; and W.I. Garms. "Determinants of Educational Expenditures in Large Cities of the United States", School of Education, Stanford University, 1966. Cooperative Res. Proj. No. 2389, USOE.

Multiple regression involving: school district school expenditures, property valuations, income, percent of owner occupied housing, unemployed, non-white, elementary students in private schools, having elected school boards, etc.

72.EC Kershaw, Jos. A. and R.N. McKean. "Teacher Shortages and Salary Schedules", McGraw-Hill Book Co., N.Y. 1962.

Authors argue that skills, such as mathematics and science teaching, which are in short supply should be remunerated at rates higher than those in less demand and that present salary policies present a serious threat to the future recruitment and retention of good teachers.

73.PP Knoir, Owen A. (Ed.) Long-Range Planning in Higher Education. Boulder, Colorado: Western Interstate Commission for Higher Education, 1965.

74.SA Koenig, H.E., and Keeneg, M.G. A System Approach to Higher Education. Michigan: Michigan State University, Division of Engineering Research, May 1966.

75.MG Kornfield, L.L. and J.F. O'Hara. "Designing a Management Information System", Data Processing Digest 11:8 1965, Total Systems Letter, May 1965. Directed to university officials.

76.BC Krutilla, John V. "Welfare Aspects of Benefit-Cost Analysis", Journal of Political Economy. Vol. 69, June 1961, pp. 226-235.

77.EC Lassiter, Rog L. "The Association of Income and Education for Males by Region, Race, and Age", The Southern Economic Journal. Vol. XXXII, No. 1, July 1965, pp. 15-22.

78.EC Machlup, Fritz. The Production and Distribution of Knowledge in the United States. New Jersey: Princeton University Press, 1962.

79.EC McClintic, J.O. "California's Ability to Finance Higher Education", National Tax Journal, Vol. 15, No. 2, June 1962, pp. 170-183.

80.BC McCullough, J.D. Cost Effectiveness: Estimating Systems Costs. Bethesda, Md.: Rand Corporation, 1965.

81.EC McKie, J.W., Editor, "Education and the Southern Economy", Southern Economic Journal Supplement, July 1965, pp. 1-128.

82.EC McLoone, E.P. "California's Ability to Finance Higher Education: A Comment", National Tax Journal, Vol. 15, No. 3, Sept. 1962, pp. 330-333.

83.EC Miller, H.P. "Lifetime Income and Economic Growth", American Economic Review, Vol. 50, No. 4, Sept. 1965, pp. 834-44.

Two methods for estimating lifetime income are contrasted: cohort analysis (i.e. longitudinal studies) and cross-sectional analyses. 1950 and 1960 Census data are used to estimate increase in average personal income for U.S. males born in four different decades classified by six education categories, white-non-white, south-nonsouth. Results using both methods are shown.

84.EC Miller, H.P. "Income Distribution in the United States", U.S. Bureau of the Census, G.P.O. Washington 1966, 306 pages.

Chapter 4, "Income and Education" is an extension of the ideas and tabulations in Miller's 1965 article.

85.EC Miller, W.L. "The Economics of Education in English Classical Economics", Southern Economic Journal. Vol. XXXII, No. 3, Jan. 1966.

86.EC Mincer, Jacob. "On-the-Job Training: Costs, Returns, and Some Implications", Journal of Political Economy. Vol. LXX, No. 5, Oct. 1962, pp. 50-79.

87.EC Miner, Jerry. Social and Economic Factors in Spending for Public Education.

The Economics and Politics of Public Education, No. 11. Syracuse Univ. Press, 1963.

88.EC Morgan, J.N.; David, M.H.; Cohen, W.J.; and Brazer, H.E. Income and Welfare in the United States. New York: McGraw-Hill, 1962.

89.EC Morgan, J. and M. David, "Education and Income", Quarterly Journal of Economics, Vol. 77, Aug. 1963, pp. 423-37.

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92.EC Nelson, Richard R. and Phelps, Edmund S. "Investment in Humans, Technological Diffusion and Economic Growth", American Economic Review, Paper and Proceeding of the 78th Annual Meeting. Vol. LVI, May 1966, pp. 69-75.

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Public Finance, Vol. 21, No. 1-2, pp. 200-05.

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101.EC Organization for Economic Co-operation and Development. Forecasting Educational Needs For Economic and Social Development. Paris: 1962.

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106.MG Platt, W.J. "Education - Rich Problems and Poor Markets", Management Science, Vol. 8, No. 4, July 1962, pp. 408-418.

Distinguishes three key decisions being made vis-a-vis education:
1. Proportion of total resources devoted to Education
2. Resource allocation within Education
3. Organization within Educational unit.

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110 .OR Quade, E.S. Analysis for Military Decisions. Santa Monica, California: Rand Corporation, 1964. (R-387-PR).

111 .BC Quade, E.S. Cost-Effectiveness Analysis: An Introduction and Overview. Santa Monica: Rand Corporation, 1965. (AS36,R331 P3134).

112 .MV Ratliff, C.E., Jr. "Centralization, Ability and Effort in School Finance", National Tax Journal, Vol. 13, March 1960, pp. 41-44.

Rank correlations for 48 States are determined. Centralization (*) and ability to support education (personal income per pupil) are negatively correlated. (-.343) Effort (% personal income given to schools) is highly negatively correlated with ability (-.698). (*) % of State & local revenues which are State.

113 .EC Renshaw, E.F. "A Note on The Expenditure Policy of State Aid to Education", Journal of Political Economy, Vol. 68, pp. 170-74, April 1960.

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115 .MV Riew, John. "Economies of Scale in High School Operation", The Review of Economics and Statistics, August 1966.

A multiple regression model is developed on 109 selected Wisconsin high schools regressing operating expenditures on enrollment, enrollment squared, teachers salary, change in enrollment, etc.

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118 .EC Schultz, T.W. "The Economic Value of Education", Columbia University Press, New York, 1957, 442 pp.

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120 .EC Schultz, T.W. "Investment in Human Capital", American Economic Review, Vol. 51, March 1961, pp. 1-17.

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125.PP Smithier, Arthur. A Conceptual Framework for the Program Budget. Santa Monica, California: Rand Corporation, 1964. (AS36.R333 RM 4271-RC)

126.PP Smithier, Arthur. Government Decision Making and the Theory of Choice. Santa Monica, California: Rand Corporation, 1964. (AS36.R331 P2960)

127.EC Smolensky, Eugene. "Investment in the Education of the Poor: A Pessimistic Report", American Economic Review, Papers and Proceedings of the 78th Annual Meeting. Vol. LVI, May 1966, pp. 370-378.

128.EC Soltow, L. "The Distribution of Income Related to Changes in The Distribution of Education, Age and Occupation", Review of Economics and Statistics, Vol. 42, Nov. 1960, pp. 450-53.

129.MV A Stanford Research Institute, An Age-Specific School Attendance Profile for Drop-Out Analysis. (Available through ERIC, as Technical Note No. 9)

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134.EC Stone, Richard. "Input-output and Demographic Accounting: A tool for Educational Planning", Minerva, Vol. 4, No. 3, Spring 1966, pp. 365-380.

A refinement of Stone 1965 showing the educational system as an input-output model in a more general demographic context.

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Community educational choice model used to explore private, public and mixed financing with the last providing the greatest support for education. Comment by E.F. Renshaw, pp. 35-38.

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138.EC Tropp, Asher. "The Social Function of Education Systems", Social and Economic Studies, Selected Papers on Education Presented at the 7th Latin-American Congress of Sociology, 1964.

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140.EC Universities - National Bureau Committee for Economic Research. Public Finances: Needs, Sources, and Utilization. Princeton: Princeton University Press, 1961.

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145.EC Weisbrod, B.A. "Education and investment in Human Capital", Journal of Political Economy, Vol. 70, Supplement Oct. 1962, pp. 106-23.

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147.EC Weisbrod, Burton A. "Investing in Human Capital", Journal of Human Resources, Sum. 1966, pp. 5-21.

148.EC Welch, Finis. "Measurement of the Quality of Schooling", American Economic Review, Papers and Proceedings of the 78th Annual Meeting. Vol. LVI, May 1966, pp. 379-392.

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Cost Analysis concepts, noting differences between universities, departments, levels of education, direct instructional costs and indirect costs. University of Michigan as an example.

150.OR Winthrop, Henry. "Contemporary Intellectual Ferment and the Curriculum of the Future", The Social Studies, Vol. 41, No. 3, Mar. 1965, pp. 83-89.

151.EC Wiseman, J. "The Economics of Education", Scottish Journal of Political Economy, Vol. 6, Feb. 1959, pp. 48-58.

152.BC Wiseman, J. "Cost-Benefit Analysis in Education", The Southern Economic Journal, Vol. 32, No. 1, Part 2, Supplement July 1965, pp. 1-12.

153.EC Woodhall, M. and M. Blaug. "Productivity Trends in British University Education 1938-62." Minerva, Vol. 3, No. 4, Sum. 1965, pp. 483-98.

10.A.BC Abt Associates, Inc. Design for An Elementary Cost-Effectiveness Model. Volume 1, Model Description; Volume 2, The User's Guide. Cambridge, Massachusetts, June 1967.

128A.BC Spiegelman, Robert et al. Stanford Research Institute, Cost-Benefit Model to Evaluate Educational Programs. (Progress Report), March 1967.

Appendix A

Most of the studies in this bibliography are included in one or more of the following bibliographies:

1. Blaug, Mark

   Economics of Education: a Selected Annotated Bibliography
   Pergamon Press, Oxford, 1966

   This is an outstanding work having 792 well-annotated entries. The entries are chronologically ordered but alphabetical within years in 23 categories. Author and country indices are included. A discussion which compares entries is provided with each category.

2. Deitch, K.M. and E.P. McLoone

   The Economics of American Education: A Bibliography
   Phi Delta Kappa, Inc. 1966
   724 entries in 20 categories; author index

3. Schultz, T.W.

   The Economic Value of Education
   Columbia University Press, New York, 1963
   selected bibliography pp. 71-89
   222 entries in 5 categories

4. Research in Education: a monthly periodical published by the U.S. Office of Education beginning in November 1966.
   This gives concise resumes of reports on OE-funded projects completed and in progress. Each is indexed by author, institution, subject, authorizing legislation and contract number.

5. Wright, Gordon

   A Selected Annotated Bibliography on Educational Systems

   Working Paper No. 1. Division of Organizational Sciences,
   Case Institute of Technology, April 1, 1966;
   225 entries by author; entries classified into 7 categories.
   This work comes closest to attaining the objectives of this bibliography in that it is specifically OR and Systems oriented.

6. Vincent, Howard L.

   Selected Bibliography: Application of Operations Research and Economics to Educational System Studies. (Technical Note No. 2)
   This initial work by Vincent was the basis from which the present bibliographic guide is an expansion and updating.

APPENDIX B

LIST OF TECHNICAL NOTES
OF THE DIVISION OF OPERATIONS ANALYSIS

(Available through ERIC, see footnote, page 2)

TN-1 ANALYZING DIFFERENCES IN THE GROWTH OF TWO RATIOS. Edward Zabrowski, May 24, 1966.

TN-2 SELECTED BIBLIOGRAPHY: APPLICATION OF OPERATIONS RESEARCH AND ECONOMICS TO EDUCATIONAL SYSTEM STUDIES. Howard Vincent, July 15, 1966.

TN-3 CONSTRUCTING A MINIMAL-LENGTH AREA-CONSERVING FREQUENCY POLYGON FROM GROUPED DATA. C. Marston Case, July 15, 1966.

TN-4 EDUCATIONAL QUALITY: DEFINITION AND MEASUREMENT. Frederic D. Weinfeld, September 2, 1966.

TN-5 PROGRAM BUDGETING FOR EDUCATION. Howard L. Vincent, September 15, 1966.

TN-6 THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT 1966 SYMPOSIUM ON THE APPLICATION OF OPERATIONS ANALYSIS TO EDUCATIONAL PROBLEMS. David S. Stoller, October 6, 1966.

TN-7 A TECHNIQUE FOR PROJECTION OF OCCUPATIONAL-EDUCATIONAL REQUIREMENTS FOR STATE EDUCATIONAL PLANNING AREAS. William C. Morsch, November 18, 1966.

TN-8 AN EXAMINATION OF DATA ON IOWA SCHOOL CHILDREN TO DETERMINE PATTERNS OF PERFORMANCE. Abt Associates, Inc., November 17, 1966.

TN-9 AN AGE-SPECIFIC SCHOOL ATTENDANCE PROFILE FOR DROP-OUT ANALYSIS. Stanford Research Institute, November 17, 1966.

TN-10 ON DEPARTURES FROM INDEPENDENCE IN CROSS-CLASSIFICATIONS. C. Marston Case, November 18, 1966.

TN-11 BIRTHS AND DEATH RATE PROJECTIONS USED IN STUDENT-TEACHER POPULATION GROWTH MODELS. Tetsuo Okada, November 14, 1966.

TN-12 ESTIMATION OF AGE TRANSITION PROBABILITIES. Judith R. Zinter, December 8, 1966.

TN-13 SOME QUANTITATIVE ASPECTS OF THE INSTRUCTIONAL PROCESS. William J. Gavin and Murray Spitzer, December 9, 1966.

TN-14 AN OVERVIEW OF THE ELEMENTARY AND SECONDARY COST-EFFECTIVENESS MODEL AND SUBMODELS. Abt Associates, Inc., December 9, 1966.

TN-15 THE SCHOOL SUBMODEL. Abt Associates, Inc., December 9, 1966.

TN-16 THE INSTRUCTIONAL PROCESS SUBMODEL. Abt Associates, Inc., December 9, 1966.

TN-17 THE COMMUNITY SUBMODEL. Abt Associates, Inc., December 9, 1966.

TN-18 THE COST SUBMODEL. Abt Associates, Inc., December 9, 1966.

TN-19 THE EFFECTIVENESS SUBMODEL. Abt Associates, Inc., December 9, 1966.

TN-20 THE COMPUTATION. Abt Associates, Inc., December 9, 1966.

TN-21 FACTOR ANALYSES OF ACHIEVEMENT MEASURES FROM THE EDUCATIONAL OPPORTUNITIES SURVEY. George W. Mayeske and Frederic D. Weinfeld, January 18, 1967.

TN-22 EDUCATIONAL ACHIEVEMENT AMONG MEXICAN AMERICANS: A SPECIAL REPORT FROM THE EDUCATIONAL OPPORTUNITIES SURVEY. George W. Mayeske, January 9, 1967.

TN-23 (In Preparation)

TN-24 URBAN EDUCATION SYSTEMS ANALYSIS. Stephen C. Clark, Richard J. O'Brien, and C. Marston Case, January 20, 1967.

TN-25 REPORT ON THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT 1967 CONFERENCE ON SYSTEMS TECHNIQUES IN EDUCATIONAL PLANNING. David S. Stoller, February 10, 1967.

TN-26 A STUDY OF LONGITUDINAL PATTERNS OF FAILURE AMONG HIGH SCHOOL DROP-OUTS AND POORLY PERFORMING GRADUATES. Abt Associates, Inc., February 16, 1967.

TN-27 COST-BENEFIT ANALYSIS OF EDUCATION. Alexander M. Mood and Richard Powers, March 30, 1967.

TN-28 DROP-OUT AND RETENTION METHODOLOGY USED TO ESTIMATE FIRST STAGE ELEMENTS OF THE TRANSITION MATRICES FOR DYNAMOD II. John T. Hudman and Edward K. Zabrowski, April 20, 1967.

TN-29 (Cancelled)

TN-30 COST MODEL FOR LARGE URBAN SCHOOLS. Richard J. O'Brien, April 26, 1967.

TN-31 (In Preparation)

TN-32 ITEM RESPONSE ANALYSES OF THE EDUCATIONAL OPPORTUNITIES SURVEY TEACHER QUESTIONNAIRE. George W. Mayeske, Frederic D. Weinfeld, and Albert E. Beaton, Jr., May 18, 1967.

TN-33 (In Preparation)

TN-34 STUDENT-TEACHER POPULATION GROWTH MODEL: DYNAMOD II. Edward K. Zabrowski, John T. Hudman, Tetsuo Okada, and Judith R. Zinter, May 29, 1967.

TN-35 AN ALGORITHM TO DETERMINE RELATIVE IMPORTANCE OF PROJECTS. William K. Winters, May 31, 1967.

TN-36 METHODS OF PROJECTING BIRTHS. Tetsuo Okada, June 1, 1967.

TN-37 (In Preparation)

TN-38 SCHOOL SUBMODEL FOR LARGE URBAN SCHOOLS. Richard J. O'Brien, June 21, 1967.